GOLDEN MAHSEER AND OTHER SPORT FISH CONSERVATION IN UTTARANCHAL

Golden mahseer catch, photograph and release programme in Uttaranchal

In his quest for this fine fish the angler is taken into wild surroundings amidst some of the finest of nature's scenery. It may be that he will find his sport in the Himalayas, where is the grandest scenery in the world, and where the turbulent river winds its way through dark gorges clad in fir groves and rhododendrons with perhaps a glimpse at the head of the valley of the Eternal Snows….Macdonald, 1948.

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SUMMARY

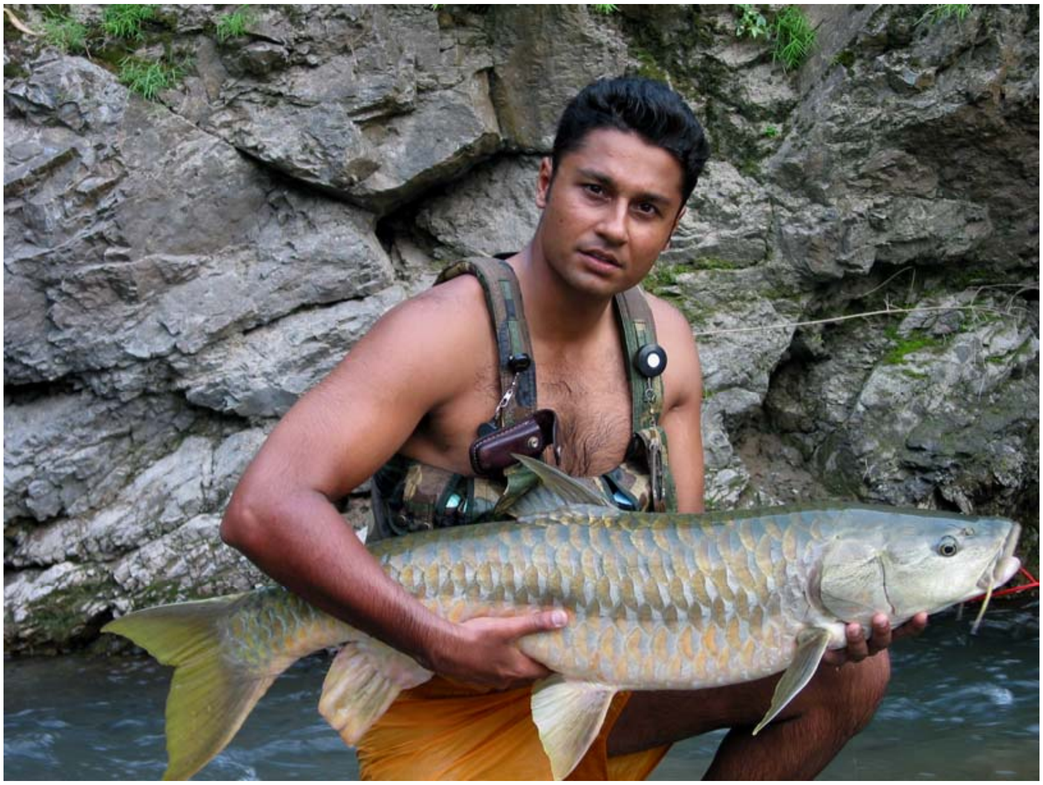
Species of sport fish like golden mahseer offer a splendid ecotourism potential, and the Government of Uttaranchal should strive to conserve them in order to enhance the prospects of nature tourism opportunities in the State. The golden mahseer is a stream-lined, yellow-finned and beautiful fish, and has several attributes which make it extremely vulnerable to extinction. In relation to body mass the fish produces less number of eggs than the commercially exploited species (e.g. rohu and catla), the eggs take longer time to hatch and the semi-quiescent stage soon after hatching is much longer making it extremely vulnerable to predation. The fish needs clean streams from July to September for spawning and large and long rivers or reservoirs in the lower altitudes in the months of October to June for wintering, feeding and replenishing for the next breeding season. In Uttaranchal the golden mahseer is largely confined to lotic habitats (streams and rivers). The abundance of the fish over the decades has declined drastically as the fry, fingerlings and brooders are killed in the spawning streams by destructive ways of fishing such as dynamiting, poisoning and electrocution. Further, in three river systems (Yamuna, Ganga and Sharada) the fish has lost its feeding or wintering habitat as a result of hydel and irrigation projects. The loss of feeding or wintering habitat in Yamuna river is so severe that the future of the fish in the Yamuna drainage is bleak. Mahseer habitats in Yamuna, Ganga and Sharada rivers are further threatened by new hydel-power projects that are being planned. Ramganga drainage has immense potential for saving this species, as most of the drainage comes within Corbett Tiger Reserve but even here the fishes are killed when they ascend the streams for spawning. We suggest recommendations which would help saving the mahseer, and other sport fish species not just in Uttaranchal but across the country.

Introduction:

The mountainous state of Uttaranchal, carved out of Uttar Pradesh on 9th November 2000, is endowed with the bounties of nature: lofty snow peaks, aesthetic *bugyals* or alpine meadows, imposing glaciers, scenic conifer forests, numerous rivers that offer opportunities for angling and water sports, and *bhabar* forests with abundance of wildlife including tiger (*Panthera tigris*) and elephant (*Elephas maximus*). All these give Uttaranchal the potential to be a great destination for nature tourists. The streams and rivers of Uttaranchal have many sport fishes such as the introduced rainbow trout (*Onchorynchus mykiss*), snow trout (*Schizothorax richardsonii* found throughout Uttaranchal and *S. kumaonsis* endemic to Kumaon), Indian trout (*Barilius bola*), *goonch* (*Bugarius bugarius*), black mahseer (*Tor chelynoides*), red-finned tor mahseer (*Tor tor*) and yellow-finned golden mahseer (*Tor putitora*). Among these, one species that needs the immediate attention of the Government and can significantly enhance the value of Uttaranchal as a destination for anglers, is the golden mahseer, the commonest of all mahseer. Corbett (1944) opines that fishing for mahseer in a well-stocked submontane river is the most fascinating of all forms of sport and a sport fit for kings. Efforts to protect golden mahseer, which has the attributes of a flagship species (Simberloff 1998), would greatly improve the conservation status of other biota in the aquatic ecosystems in Uttaranchal.

Morphology and biology pertinent to conservation:

Golden mahseer is a fresh water carp belonging to the family *Cyprinidae*, occurring widely all along the foothills of Himalaya (Day 1878, Jhingran 1983, Jayaram 1999). It is one among the 11 species of mahseer that occur in Asia and one of the nine in India (Rainboth 1990). The recorded maximum size of golden mahseer is 2.74 m. The maximum published weight is 54 kg (Rahman 1989). Hora (1939) gives the following diagnostic morphological features of golden mahseer: it has a streamlined, somewhat compressed (i.e. flattened from side to side) body. Its head is longer than the depth of the body. The eyes are far forward and provided with circular pupils. Eyes are proportionately larger in the smaller individuals. The mouth is small, its gape does not extend to below the eyes, the lips are fleshy and there are two pairs of barbels.



Golden mahseer showing diagnostic morphological characteristics

The body is covered with large scales (in the past, in some parts of India, the scales were used as playing cards, Lacy and Cretin 1895). There are 25-28 scales in a longitudinal series along the lateral line. The commencement of the dorsal fin is opposite to that of the pelvic, and is almost midway between the tip of the snout and the base of the caudal fin. The last spine of the dorsal fin is strong and bony. Dhu (1923) reports that there are 2 ½ scales between the base of the ventral fin and lateral line.

The fertilized eggs measure 2.8 to 3.2 mm and they take 58-192 hrs to hatch in water temperature of 16^o to 25^oC (Sehgal 1991). This is comparable to the 18 hours for the catla (*Catla catla*) and rohu (*Labeo rohita*). The fecundity of mahseer as compared to the commercially exploited species is very low. For example, the Deccan or khudree mahseer (*Tor khudree*) lays 6000 eggs/kg body weight as compared to 2,61,000 of rohu and 1,33,000 of catla. The eggs of mahseer, being comparatively heavier than those of rohu and catla, are demersal (capable of sinking in the mud) and therefore, if there is mud on the river bed instead of sand or gravel, they can sink and perish. Further, the semi-quiescent stage, soon after hatching, when they are highly vulnerable to all kinds of predation, is three days for catla and rohu and six days for khudree mahseer. All these make the mahseer extremely vulnerable to all forms of threats (Kulkarni and Ogale 1978).

The fry and fingerlings feed on diatoms, ciliates, rotifers, crustaceans and other fish fry (Sehgal *et al.* 1971). Hora and Mukherjee (1936) found that golden mahseer have a relatively short intestine, indicating a more carnivorous diet than the sympatric *Tor tor*. The fingerlings of golden mahseer are zoophagous (Pathani and Joshi 1979) and the adults when compared with fingerlings more herbivorous (Das and Pathani 1978). Macdonald (1943) reports mahseer waiting under bridges over the Ganges canal near Haridwar for young martins (e.g. Dusky Crag Martin *Hirundo concolor*) to fall out of their nests. Females (spawners) attain greater size than the males (milter) (MacDonald 1943). Males mature when they are two years old and attain a total length of ca. 200 mm; females reach a length of 300 mm, maturing at around three years (Pathani 1983).

Ganga river still has immense potential for mahseer conservation

Kali, (Sharada), above Jaulgibi, is avoided by mahseer as the water is snow fed. Snow trout here are decimated by the use of bleaching powder when they ascend the streams for spawning in July-September.

Information on spawning is confusing. Thomas (1897) stated that the fish spawns thrice a year, once in winter (January-February), again in May-June when the rivers are swollen with snow melt water, and finally from July to September when the rivers are flooded due to south-west monsoon. Based on the collection of fertilized eggs and hatchlings from Baner stream in Himachal Pradesh, Sehgal *et al.* (1971) report that mahseer breed during May-June and August-September. Nautiyal and Lal (1984), based on their work in the Ganga waters, record a triphased migration linked to food supply: fish swim up the main river (Alaknanda), into the spawning streams, and return to the main river after spawning. The best information comes from Beavan (1877) and Lal (1963), who report that mahseer ascend the rivers and hill-streams to breed with the onset of rains from July to September. Lal further noted that the fish were scarce and usually not available at lower altitudes during the above months, consistent with an upstream monsoonal migration. Lal was not able to collect any fish around Chamoli, at an altitude of about 5500’, suggesting that golden mahseer, possibly to avoid very cold waters, does not ascend beyond certain altitude. On dissection, fish collected during the months of April, May and June were found to possess ova in different stages of maturity, depending on the age of the fish. Mahseer caught during winter had undeveloped gonads. Therefore, the major spawning season most likely coincides with the rains from July to September. Fresh warm rain water flowing from the streams may induce the growth and maturation of ova before spawning leading to the migration from the main river, which serves as a feeding and wintering habitat. Since reproduction is biologically and physiologically expensive for the females (Wootton 1990), individual fish may not breed twice or thrice a year although some individuals in a population may be induced to breed by the winter or summer rains. The presence of four groups of eggs of different sizes in females (Pathani 1983), however, indicate that during one breeding season some fish may spawn four times. In many upstream spawning species like some species of salmon and perch, the energetic costs involved in the spawning process cause significant mortality (Henderson and Tocher 1987, Newsome and Leduc 1975). Interestingly though, mahseer do not die after spawning, as most salmon do (Mills 1989), and they return to the main river in October. This suggests that mahseer may not be as energetically constrained as some upstream spawning fish, and there is a need for a detailed study of its behavioural energetics.

Golden mahseer habitat in Uttaranchal:

The habitat of the Golden mahseer, as anywhere else, is largely confined to lotic environments (streams and rivers). Lentic habitats (reservoirs and lakes) are a few (Fig. 1). The lakes in Kumaon Himalaya were stocked with golden mahseer by Sir H. Ramsay around 1858. The Bhimtal, the Nakuchiatal and the Sathtal were stocked with fingerlings transported in earthen vessels from the Gola river, and Nainital with those from Kosi river. The fish took well to the confined waters and bred in the shallow areas of the streams that drain into the lakes (Jones and Sarojini 1952). Now, however, mahseer are either extinct or rare in Nainital, Nakuchiatal and Sathtal although a small population lingers in Bhimtal. The Ramganga (Kalagarh) reservoir, commissioned in 1976 across Ramganga river, has the best population of mahseer and *goonch* in Uttaranchal. Mahseer status in Nanaksagar is depleted due to regular and intensive commercial and uncontrolled fishing practices including destructive methods of fishing in Nandhour river, the major spawning habitat of mahseer of Nanaksagar. Thumaria, Deoha and Dhora reservoirs have little or no mahseer.

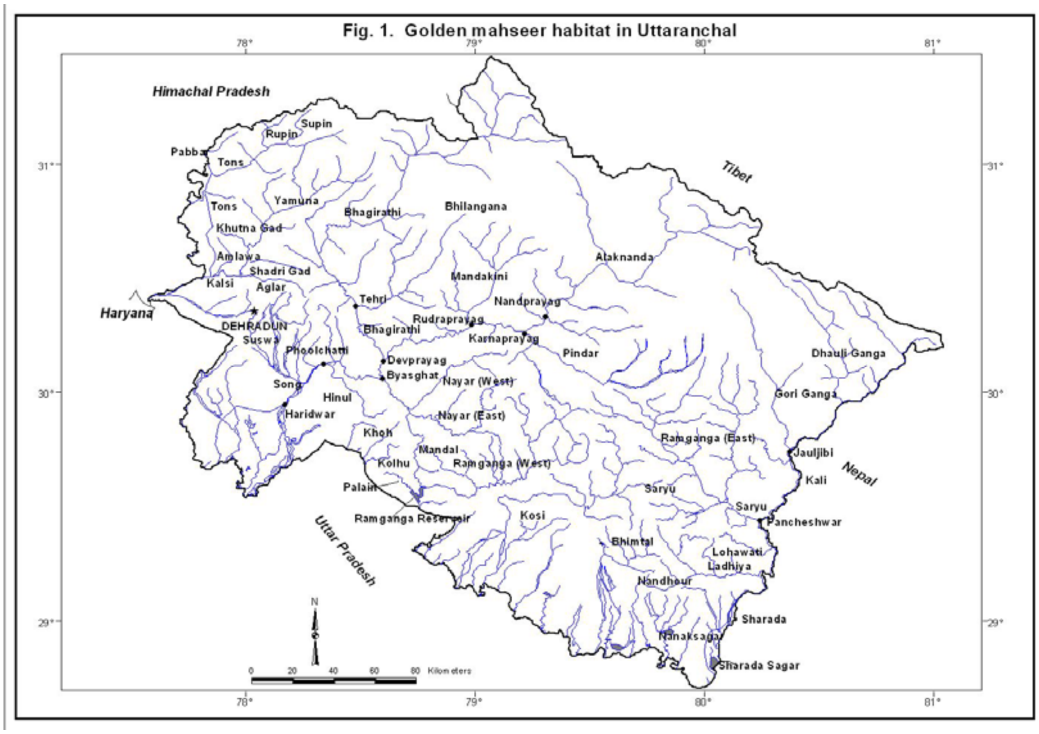


Fig. 1. Golden mahseer habitat in Uttaranchal

The major lotic habitats are Sharada and its tributaries, Ramganga and its tributaries, Ganga and its tributaries, and Yamuna and its tributaries. Existing literature clearly shows that mahseer avoid snow fed rivers such as the Tons. Although a tributary of the Yamuna and larger than Yamuna, it holds hardly any mahseer, which is replaced by snow trout (*S. richardsonii*). However, at the confluence of Tons and Yamuna, >50 lbs fish were caught in the early part of 1960s (Honorary Secretary 1961). The Keeper at the Inspection bungalow at Rudraprayag informed Corbett (1947) that there was good fishing in Mandakini and Alaknanada in spring (March and April) before the snow-water advanced, suggesting that the fishes retreat to the lower stretches of the rivers (Alaknanda and Ganga) with the snow melt. Pindari river (a tributary of Alaknanda, arising from Pindari glacier), Bhagirathi (arising from Gaumukh glacier) and Bhilangana (a tributary of Bhagirathi, arising from Khatling glacier) are not mentioned in sport-fishing literature as a favourite abode of mahseer, although they are known to occur there (Sharma 1987). Similarly Gori Ganga (which arises from Milam glacier), and drains into Kali (Sharada) at Jauljibi, has few mahseer.

Tons, a tributary of Yamuna, being a snow fed river is avoided by mahseer. Tons is still a stronghold of snow trout.

The future of mahseer in Yamuna river is bleak as a result of hydel projects

The best habitat for mahseer in the Ganga presently lies between Karnaprayag and Rishikesh and in its major tributaries, Mandakini and Nayar. Numerous smaller tributaries also drain into this river system. About 350 km along these streams and river are favoured habitat of the mahseer. We do not know how the proposed Vishnu Prayag and Srinagar Hydel projects will affect mahseer in the Ganga watershed. Since water from the Ganga is diverted to the Chilla power channel at Rishikesh, the 16 km stretch of the river between Rishikesh and Haridwar, once a fine winter and feeding habitat, now has less water. Mahseer occur here in very low abundance, and are subjected to regular illegal gill-netting. Even the population of mahseer which occurred in Haridwar (which served as an asylum in the past) has dwindled over the years. This is due to the sluice gate in the canal that takes water to Haridwar and which the fish have to cross to enter the main river. Uncontrolled fishing in the past, and now polluted waters from Dehra Dun township, garbage, and heavy siltation caused by large-scale sand and boulder collection, have led to the drastic decline of mahseer in Song river, the only tributary where mahseer can go to spawn between Haridwar and Rishikesh. All these have gradually affected the abundance of mahseer between Rishikesh and Haridwar.

Mahseer abundance in Haridwar has declined drastically as a result of destructive methods of fishing in Song river, the only spawning habitat between Rishikesh and Haridwar. Song is polluted by effluents from Dehra Dun city and gravel collection in the river bed.

Corbett Tiger Reserve offers some degree of protection to mahseer in Ramganga river and reservoir but most fishes get decimated as they ascend Ramganga, Mandal and Palain for spawning.

The proposed hydel project at Pancheshwar may alter the potential of Sharada as the fortress of mahseer.

The Yamuna has tributaries such as Amlawa, Aglar, Bhadri Gad, Kutna Gad, Baral Gad and Kamal river and may have 150 km mahseer habitat, but its potential has suffered greatly as a result of developments related to hydel power production. In 1960-1965, a barrage was built at Dakpathar, about 6 km below Kalsi (Tons-Yamuna confluence). From here, much of the water from the river is diverted to a 14.3 km power channel to Dhakrani and Dhalipur power houses. As a result, the winter or feeding habitat available to mahseer in Yamuna, restricted between the barrage and Tons-Yamuna confluence, has too little water. The construction of Ichari dam across Tons, 12 km upstream from Kalsi, and the Chibro and Khodri power houses, which use Tons water, have also affected the water availability above Dakpathar. The fish abundance below Dakpathar and Asan barrage, isolated from the main population above the Dakpathar barrage, is probably extremely low. The Lakhwar-Vyasi 420 MW hydel project on the Yamuna, which was under construction for more than a decade since the mid 1980s, and where only 60% of the work has been completed, is now lying idle for want of funds. This project has led to a lot of disturbance along the Yamuna river and may resume with renewed construction activities any time.

One major problem with such projects is the unlimited availability of dynamite which is misused by people to kill fish. Yamuna and its tributaries are bereft of large mahseer in most parts of their stretch, and one major reason for this dynamiting. In November 2005, one restaurant owner in Damta, a small town on the banks of Yamuna, reported that until 15 years ago, the local fisherman supplied him large fish (5-10 kg) and now he gets only 100-200 gm fish at the rate of Rs.40/kg. There are more dams in the offing in the Yamuna drainage: Lakhwar dam (planned below Aglar-Yamuna confluence) and Kishau dam in Tons (see URL: http://www.uttaranchalirrigation.com for the location of these dams) and these would make more dynamites available. If destructive ways of fishing such as dynamiting, poisoning, gill-netting and electrocution are not controlled the mahseer in Yamuna drainage would have a bleak future.

Ramganga river and its tributaries, Mandal and Palain, a 60 km stretch of mahseer habitat, and the reservoir (80 km^2 when full), all within the Corbett Tiger Reserve (TR), show great promise for mahseer conservation in Uttaranchal. Yet, even this habitat suffers as a result of dynamiting in both the tributaries and in the upper reaches of Ramganga. There are about 20 fishermen in Ramnagar and they make a living by selling fish. They get licenses from Ramnagar Divisional Forest Officer to fish in the Kosi river (where most of the fish are protected by the Infinity Resorts and the Garjia temple) and in Thumaria dam. It is likely, that as rumoured, some of the fish in the market may come from the illegal catch in Ramganga river and the reservoir. The on-going conservation plan of Uttaranchal Government leasing out 2-km stretches of Ramganga river above Domunda to different anglers' association is a welcome step, as the different associations can (should) protect stretches of river leased out to them from dynamiting, poisoning and gill-netting particularly during the spawning season (July-September). Yet the fact that a long stretch of river, above the first two-kilometer stretch from Domunda leased out to Claridges Hotel, is not leased out to any agency, makes this stretch of river extremely vulnerable to poaching. This situation needs to be rectified at the earliest.

The Khoh and Kolhu rivers belong to the Ramganga drainage. How the Kolhu river gets mahseer is still an enigma. It is possible that during heavy rains, mahseer that dwell below the Ramganga reservoir descend (they cannot ascend the high sluice gates of the reservoir) to Khoh barrage near Sherkot and then ascend Kolhu river, travelling a distance of about 80 km.

River Sharda (Jauljibi to Tanakpur), with its tributaries Saryu, East Ramganga (a tributary of Saryu), Lohawati and Ladhiya, may have 200 km of mahseer habitat, inclusive of the nearly 20-km stretch of winter habitat between Kaladhunga and Tanakpur. The construction of a barrage at Banbasa in the 1960s and at Tanakpur (10 km upstream of Banbasa) in the late 1990s has led to the loss of a long stretch of wintering habitat below Banbasa for the fish population, which is now largely confined above the Tanakpur barrage. Although destructive ways of fishing are rampant in all the tributaries of the Sharada, and netting by Nepalese is widely prevalent in short stretches of the river below Kaladhunga, the scope for mahseer conservation in the Sharada is still immense. The proposed Pancheshwar Hydel Project, however, is a grave threat to this fabulous habitat.

Chilla power channel and the barrage at Kunaun (Rishikesh). Diversion of water has made the downstream habitat below Kunaun, a distance of 16 km till Haridwar, a sub-optimal habitat for mahseer.

The past and the suggestions for the future:

Golden mahseer was once exceedingly abundant in the waters of Uttaranchal. On one morning, Stevens (1905) caught 15 mahseer weighing a total of 73 lbs, at the Song-Ganga confluence, before his rod broke. Dhu (1923) reports "monsters" between Rishikesh and Haridwar. Macdonald (1935) travelled along Sharada and its tributaries on a two-month fishing holiday (total 100 hrs of fishing) and caught 117 fish (largest 96 pounds) which in total weighed 946 lbs. In April 1937, the Ladhya-Sharada confluence was so alive with fish that, in one evening, enough fish were caught to feed a camp of 30 people, and in October 1938, on one day, 125 fish were caught in Nandhour river (Corbett 1944, 1954).

This abundance gradually declined due to an increase in human population, with a concomitant increase in demand, changes in fishing methods, and habitat alteration. Traditional methods of fishing include use of line and hook (*kaanta*), cast nets (*jaal*), nooses (*fandi*), basket (*gowda*) trap and ichthyotoxic plants (e.g. ‘Timura’ *Xanthoxylum armatum*) (Bahuguna *et al.* 2001). These methods, which had been practiced for decades, were not possibly putting too much pressure on the fish population. These traditional techniques have given way to a host of destructive practices including blast fishing with dynamite, gill netting, bleach fishing and stun fishing (with high-voltage electricity) in spawning grounds. Additionally, siltation caused by large-scale sand, gravel and boulder collection (Nautyal and Lal 1988), and loss of winter or feeding habitats as in Yamuna, Ganga and Sharada, has taken a heavy toll on fish populations. The visitors book maintained in the Bautari forest bungalow (built in 1927), near the confluence of Saryu and East Ramganga river (where 100-300 human bodies are burnt every month, providing adequate food to the fishes), clearly records the decline of mahseer and *goonch* as a result of regular, uncontrolled dynamiting. If destructive fishing techniques are not controlled, the future of mahseer, even in Uttaranchal, where its conservation potential is better than elsewhere, seems to be rather bleak. The situation looks more ominous in the context of the several hydel projects planned in the State.

We have developed the following recommendations to ensure the future of golden mahseer in Uttaranchal, and help conservation of other fish species in the country.

- The need of the hour is to start a campaign to put an end to dynamiting, use of bleaching powder, gill nets and electricity to kill mahseer. Ending the use of dynamites could be achieved on two fronts: by use of dynamite which do not explode in water (if such a dynamite is not already available responsible institutions should be requested to produce one) and a conservation education programme for the villagers living adjacent to the mahseer habitat, forest, police and para-military personnel (e.g. Special Security Bureau force stationed along the Sharada). Conservation education against use of dynamites, bleaching powder and electricity should be carried out with the help of Educational Institutions, NGOs, Anglers Associations, Rafting Camps, Newspapers, Radio and Television.
- The presence of anglers will definitely deter fish poachers, as the senior author has seen it in the Mandal river along the northern boundary of Corbett Tiger reserve. Therefore, the Uttaranchal Government should allow anglers, with adequate regulations (see below), to fish even in the major spawning season

(July to September), as this is the season when the fish ascend the spawning streams and are extremely vulnerable to destructive ways of fishing.

- Angling as a hobby should be promoted in Uttaranchal and other states, especially among the officers of Institutions such as the Indian Military Academy, Indira Gandhi National Forest Academy, Wildlife Institute of India, State Forest Service College and Lal Bahadur Shastry National Academy of Administration. More legal use of the mahseer habitat and the revenue generated through sport fishing would be a lasting way of strengthening conservation.
- More research and monitoring of the rivers and streams are needed, as our knowledge of the fish fauna of the Uttaranchal rivers and streams is deficient. For example, we do not have an answer to the simple questions like whether mahseer still go into Song river for spawning and whether the stream that collects the seepage water from the Chilla power channel is used for spawning. .A good field identification guide with clear pictures of the fishes of the Uttaranchal, with identification guidelines and brief notes on the habitat is urgently needed. Wildlife Institute of India and Zoological Survey of India can play an active role in promoting research and developing such a guide book.
- A mahseer conservation plan should be an integral part of the new hydel projects that are being planned in Uttaranchal. Fish ladders widely used in certain developed countries (Kamula 2001) would work only when there are abundant well-protected fish populations to use them. In the existing situation in our country fish ladders may not be of much use (Agostinho *et al* 2002).
- The Government of India should bring all mahseer fishes under the purview of the Wildlife Protection Act. Placing them in any of the schedules from I to IV will make mahseer out of bounds for the anglers also, which is undesirable considering the positive role angling can play in the mahseer's conservation. Hence, a new schedule (VII) could be created to include all mahseer and other locally-abundant species like nilgai (*Boselaphus tragocamelus*), wild pig (*Sus scrofa*), black buck (*Antilope cervicapra*), black bear (*Ursus thibetanus*) and leopard (*P. pardus*) which could be hunted obtaining necessary permissions.

- Villagers in the mahseer habitat should be permitted to catch fish for their consumption by use of line and hook, nooses and cast nets. Other destructive methods should be totally banned.
- Two types of angling should be permitted: one for catch and release, and the other for the table. In the former, triple hooks with one barb should be used, and steel leads, which can cut the throat of the fish, should be avoided. In the latter, a maximum of two fish per fishing day could be permitted, and a much higher fee levied. In both the cases, however, any large (> 10 kg) golden mahseer caught should be released, as it would most likely be a female.
- The newly built Tehri dam, under the control of Forest Department, should be used to propagate snow trout, Indian trout and mahseer species, and on no account should exotic carps (e.g. *Cyprinus carpio*, which is more like a pest now in Deoria Tal), be introduced.
- Tons river (ca. 150 km), Gori Ganga (ca. 50 km), Bindari (ca. 50 km), Bilangana (ca. 50 km, above Tehri dam) and Bhagirathi (ca. 50 km, above Tehri dam) should be specifically managed for snow trout. The conservation potential of snow trout in Uttaranchal is enormous. The reported threat faced by this species is poisoning, use of plant poisons in the tributaries of Tons and bleaching powder in the tributaries of Gori Ganga when the fish ascend the streams for spawning from July to September. The locals, who catch them by cast nets and nooses, should be persuaded to give up destructive ways of fishing.
- A study should be conducted at the earliest to find out the fish supply to Ramnagar fish market. If fish come from Ramganga river and Ramganga reservoir (both are within Corbett TR) protective measures should be strengthened and efforts should be made to give alternative employment to such fisherman, as employees in the resorts on the bank of Kosi river and by providing them fish ponds to grow fish like rohu and catla and make a living.
- The Environment & Anglers Club, Dehra Dun (T: 0135 – 2654593) should play an active role in bringing all those interested in angling in Uttaranchal under one banner and strive to protect different river stretches. Large number of young anglers in the Club is a must who would be able to take forward this task for years to come.

- Uttaranchal, which is being promoted as an (herbal) environment-friendly state, must start with a proper sewage treatment plan for its capital Dehradun, whose untreated effluents and sewage are presently released in the Suswa and Song rivers, which ultimately take them to the holiest of the Indian rivers – the Ganga. This has already seriously affected mahseer abundance in the stretch between Haridwar and Rishikesh. Stringent laws are urgently needed to control these problems.

The above report brings to light the problems and prospects of golden mahseer conservation in Uttaranchal. Problems are enormous and to bring back mahseer to some level of former abundance enormous effort on the part of the State, Institutions and Individuals is needed. It is high time we take appropriate measures including awareness against destructive ways of fishing, protection, management of sewage, garbage, boulder mining, sand and gravel collection and promotion of adequate research which will not only benefit golden mahseer and other sympatric species such as *goonch* and Indian trout but different river ecosystems across Uttaranchal.

Golden mahseer conservation can bring in significant benefits to Uttaranchal

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References:

Agostinho, A. A., Gomes, L. C., Fernandez, D. R., and Suzuki, H. I. 2002. Efficiency of fish ladders for neotropical ichthyofauna. *River Research and Applications*. 18: 299-306.

Bahuguna, S. N., Uniyal, D. P., Arun Kumar and Bahuguna, M. 2001. Fishing methods and related problems in tribal area of Jaunsar-Bawar (Uttaranchal), Western Himalaya. *Ann. For*. 9: 152-162.

Beavan, R. 1877. *Hand Book of Fresh Water Fishes of India*, London.

Corbett, J. 1944. *Man-Eaters of Kumaon.* Oxford Universities Press, London.

Corbett, J. 1947. *The Man-Eating Leopard of Rudraprayag*, Oxford Universities Press, London.

Corbett, J. 1954. *The Temple Tiger and More Man-Eaters of Kumaon,* Oxford Universities Press, London

Das, S.M. and Pathani, S.S. 1978. Studies on the biology of Kumaun mahseer *Tor putitora* (Hamilton): Adaptation of the alimentary tract in relation to feeding habits, body weight and body length. *Indian J. Anim. Sci*. 48: 461-465.

Day, F. 1878. *The fishes of India: being a natural history of fishes known to inhabit the seas and freshwaters of India, Burma and Ceylon.* London.

Dhu, S. 1923. *The angler in India or The mighty mahseer*. Natraj Publishers, Dehra Dun.

Henderson, R. J. and Tocher, D.R. 1987. The lipid composition and biochemistry of freshwater fish. *Progress in Lipid Research*. 26:281-347.

Honorary Secretary (1961) Fishing notes by the Honorary Secretary *Cheetal*. 4: 60-63.

Hora, S. L. 1939. The game fishes of India viii. The Mahseers or the large scaled Barbels of India 1. The putitor Mahseer, *Barbus (Tor) putitora* (Ham). *J. Bombay nat. Hist. Soc.* 41:272-285.

Hora, S. L. & Mukerji, D. D. 1936. Fishes of the Eastern Doons, United Provinces, *Rec. Ind. Mus. Vol.* 38: 139-368.

Jayaram, K.C.1999.*The freshwater fishes of the Indian region*. Narander Publication, New Delhi

Jhingran, V. G. 1983. *Fish and Fisheries of India* (revised and enlarged 2nd edition), Hindustan Publishing Corporation (India), Delhi.

Jones, S and K. K. Sarojini 1952. *History of transplantation and introduction of fishes in India*. 50: 594-609.

Kamula, R. 2001. *Flow over weirs with application to fish passage facilities*. Dissertation. Department of Process and Environmental Engineering, University of Oulu, Oulu University Press, Finland.

Kulkarni, C. V. and Ogale, S.N. (1978). Present status of mahseer (fish) and artificial propagation of *Tor khudree* (Sykes). *J. Bombay nat. Hist. Soc.*75: 651-660.

Lacy, G.H. & Cretin, E. C. (1895). *Anglers Handbook.* North Punjab Fishing Club. 3rd ed.

Lal, M. B. 1963. Distribution and migration of *Tor putitora*. *Cheetal* .1: 54-56.

Macdonald, A. St. J. 1935. A fishing trip in Kumaon. *J. Bombay nat. Hist. Soc*. 38: 598-600.

Macdonald, A. St. J. 1943. Circumventing the mahseer and other sporting fish in India and Burma. *J. Bombay nat. Hist. Soc*. XLIV: 38-59.

Macdonald, A. St. J. 1948. *Circumventing the mahseer and other sporting fish in India and Burma*. Natraj Publishers, Dehra Dun.

Mills, D. 1989. *Ecology and management of Atlantic salmon*. Chapman and Hall, London.

Nautiyal, P and Lal, M. S. 1988. Destruction of spawning grounds of mahseer and other fish in Garhwal Himalayas. *J. Bombay nat.Hist. Soc.* 85: 311-314.

Nautiyal, P and Lal, M.S. 1984. Preliminary observations on the migratory behaviour of the Garhwal Himalayan Mahseer. *J. Bombay nat. Hist. Soc*. 81: 204-208.

Newsome, G.E. and Leduc, G. 1975. Seasonal changes in the fat content of the yellow perch (*Perca flavescens*) of two Laurentian lakes. *Journal of the Fisheries Research Board of Canada.* 32: 2214-2221.

Pathani, S.S. 1983. Studies on the spawning ecology of Kumaun mahseer *Tor tor* (Hamilton) and *Tor putitora* (Hamilton). *J. Bombay nat. Hist. Soc.* 79: 525-530.

Pathani, S.S. and Joshi, M. 1979. On the food and feeding habits of fingerlings of two Kumaun Mahseer fishes *Tor tor* and *Tor putitora* (Hamilton). *Bioresearch.* 4: 43-46..

Rahman, A.K.A. 1989. *Freshwater fishes of Bangladesh*. Zoological Society of Bangladesh. Department of Zoology, University of Dhaka.

Rainboth, W. J. 1990. The Cyprinid fishes of Southeast Asia. In: I. Winfield and J. Nelson (eds.) *The biology of Cyprinid fishes*, Chapman Hall, Inc.

Sehgal, K. L., Shah, K. L and Shukla, J.P. 1971. Observations on the fish and fisheries of Kangra valley and adjacent areas with special reference to mahseer and other fishes. *J. Inl Fish Soc.India.* 3, 63-71.

Sehgal, K.L. 1991. *Artificial propagation of the golden mahseer Tor putitora (Ham) in the Himalayas.* Sp Publ No 2.

Sharma, R.C. 1987. Food and feeding habit of *T. tor* (Hamilton) of Garhwal Himalaya. *Matsya.* 12&13, 93-100.

Simberloff, D. 1998. Flagships, umbrellas and keystones: is single-species management passé in the landscape era? *Biological Conservation.* 83: 247-257.

Stevens, E.R. 1905. A morning's mahseer fishing in the Ganges. *Indian Forester.* 31: 406.

Thomas, H.S. 1897. *The Rod in India*. 3rd ed. W. Thacker and co., London.

Wootton, R.J. 1990. *The ecology of teleost fishes*. Chapman and Hall, London.